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(74) Agent R. J. Boxall

(54) Driving Engagement with Tape-cassette Spools

(57) In a cassette tape recorder for correct axial positioning of the tape spools (12) the spool hubs (3) are resiliently urged against stops (41) on the drive spindles by members (43), whilst the cassette is supported in its operative position by means (34, 35) on the recorder which cooperate with the housing of the cassette, the arrangement being such that the spools are supported by the stops (41) at a position in the cassette housing such that the spools are entirely clear of the walls of the housing. Alternative forms of hub and drive spindle engagement are disclosed *viz.* (i) resiliently biassed balls on the spindle bearing sideways against the inner wall of the hub, and (ii) (Figure 13) an armature ring (93) of magnetic material on the hub co-operating with a magnet 94 on the drive spindle.

The drive spindles on the recorder drive the tape spools in the cassette through eccentric drive pins (32 and 105) on the spindles which engage in eccentric drive apertures in internal transverse walls in the tubular hubs of the tape spools. The hub of each spool is formed with one such wall midway between its ends, and the wall has a centring aperture for cooperation with a centring pin on the relevant drive spindle.

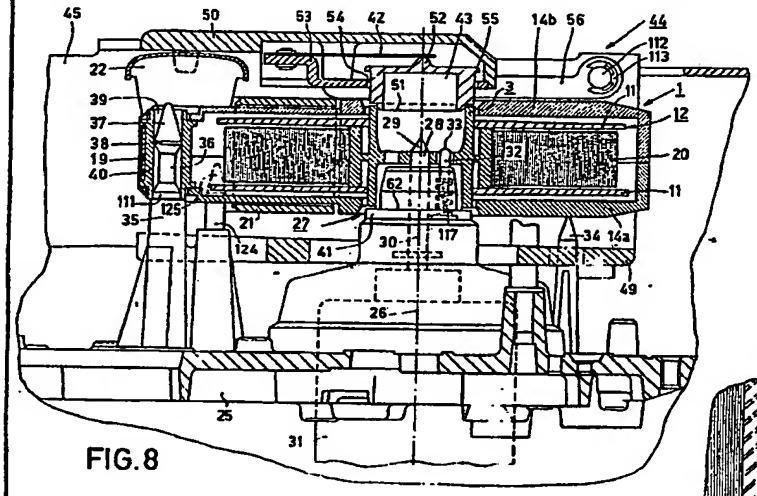


FIG.8

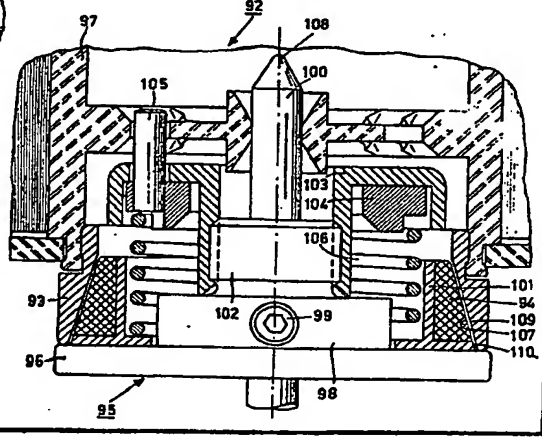


FIG. 13

GB 2 029 372 A

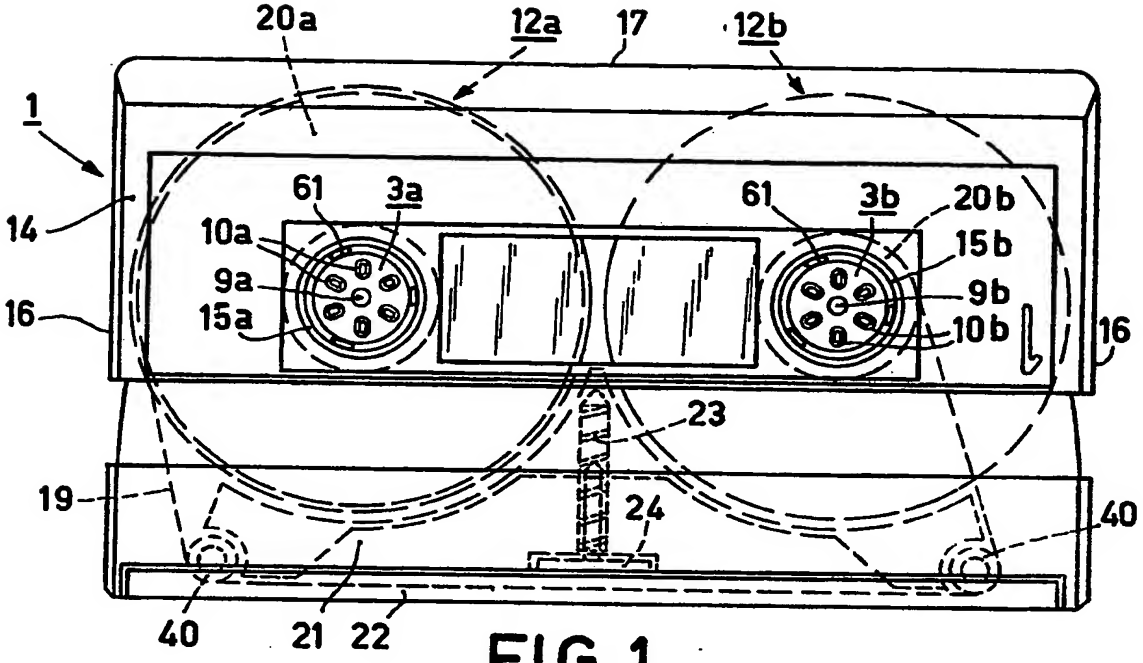

20a
12a
17
12b
1
14
61
3a
10a
9a
15a
61
3b
20b
15b
9b
10b
16
16
23
19
24
40
40
21
22

FIG. 1

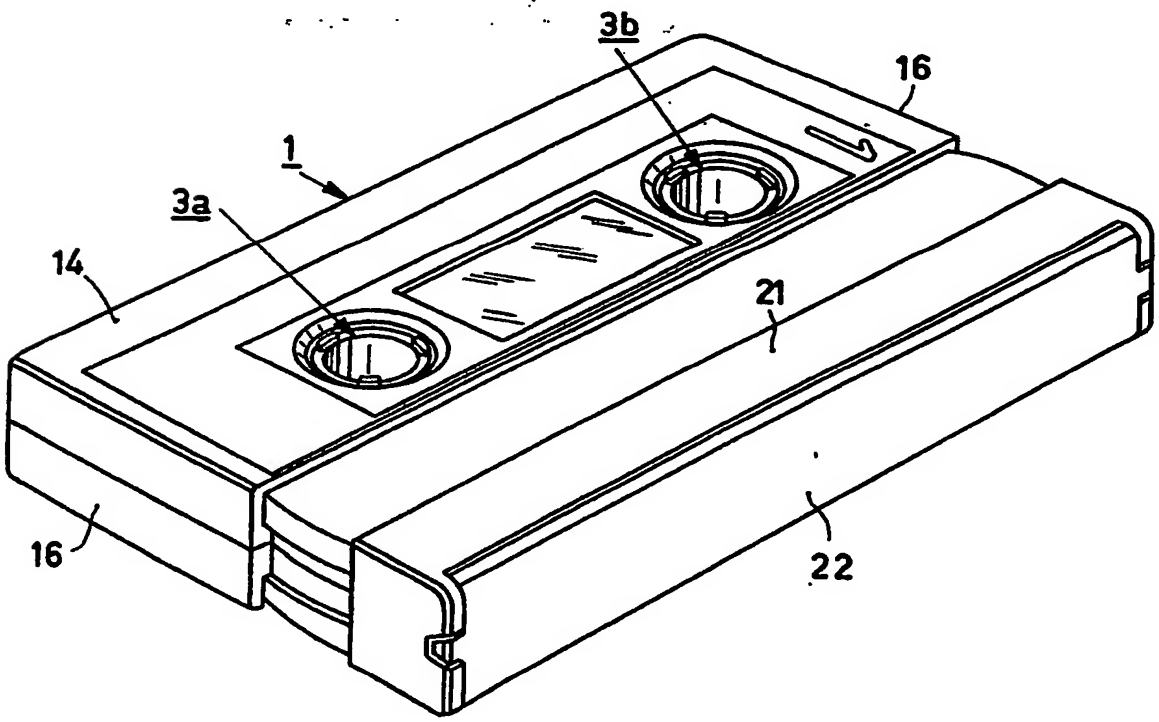

3b
16
1
3a
14
21
16
22

FIG. 2

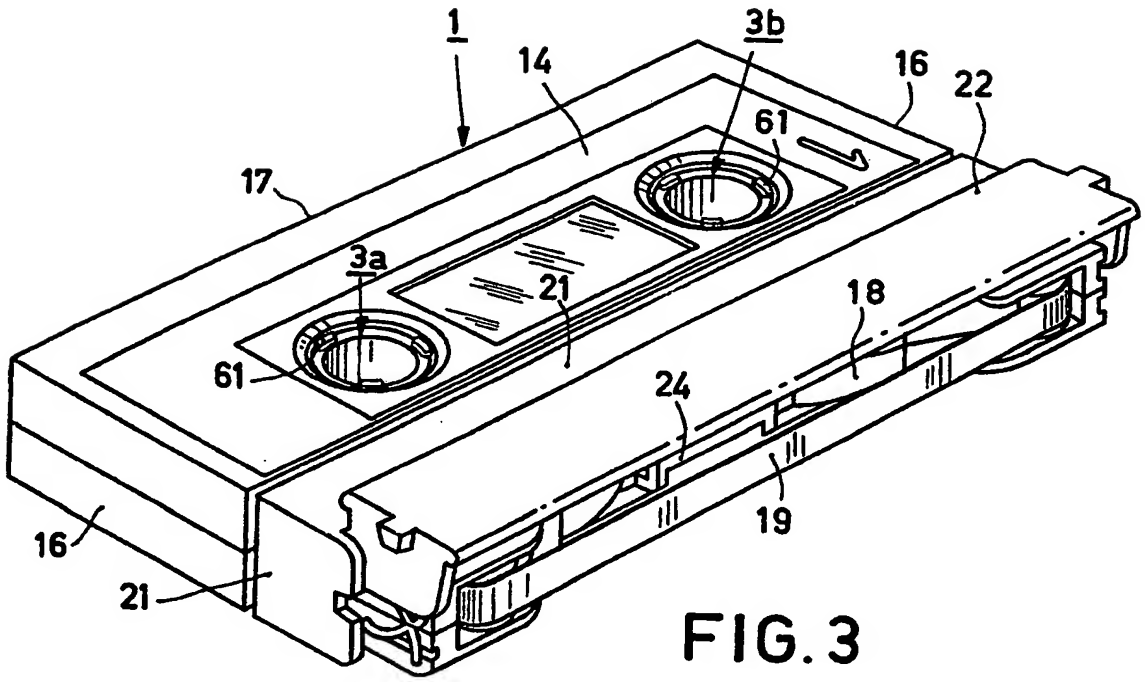

1
3b
14
16
22
61
17
3a
21
18
61
24
19
16
21

FIG.3

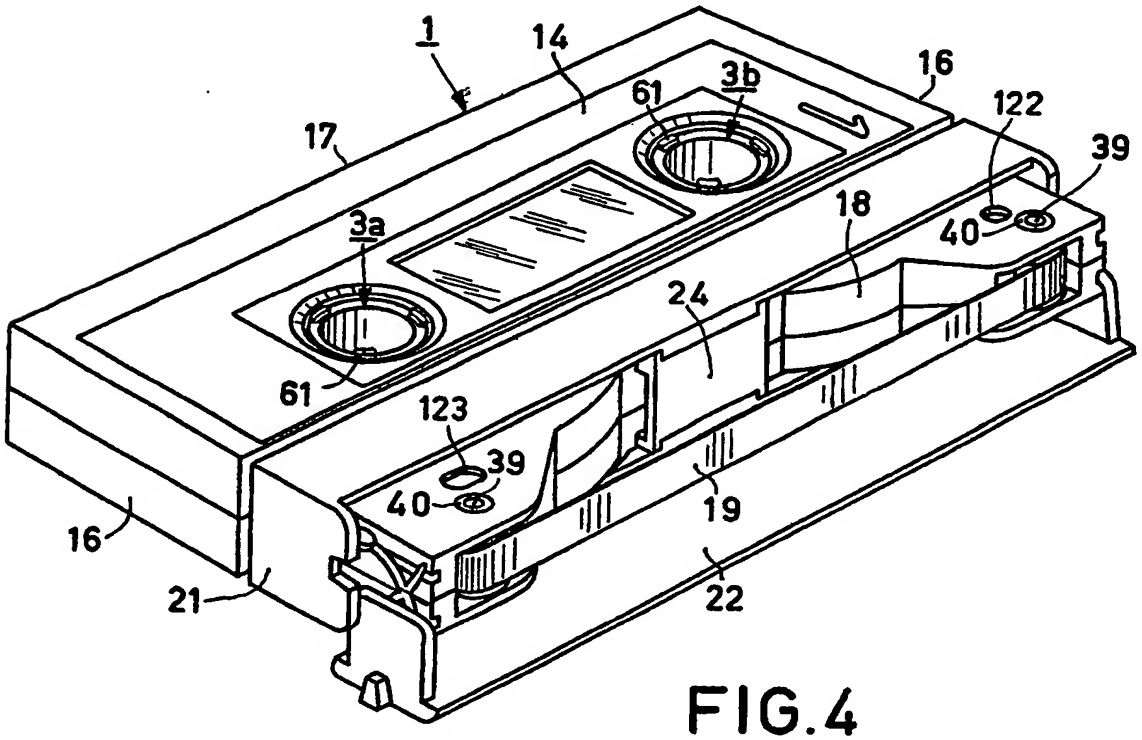

1
14
16
61
3b
122
17
39
3a
18
40
24
61
123
39
40
19
16
21
22

FIG.4

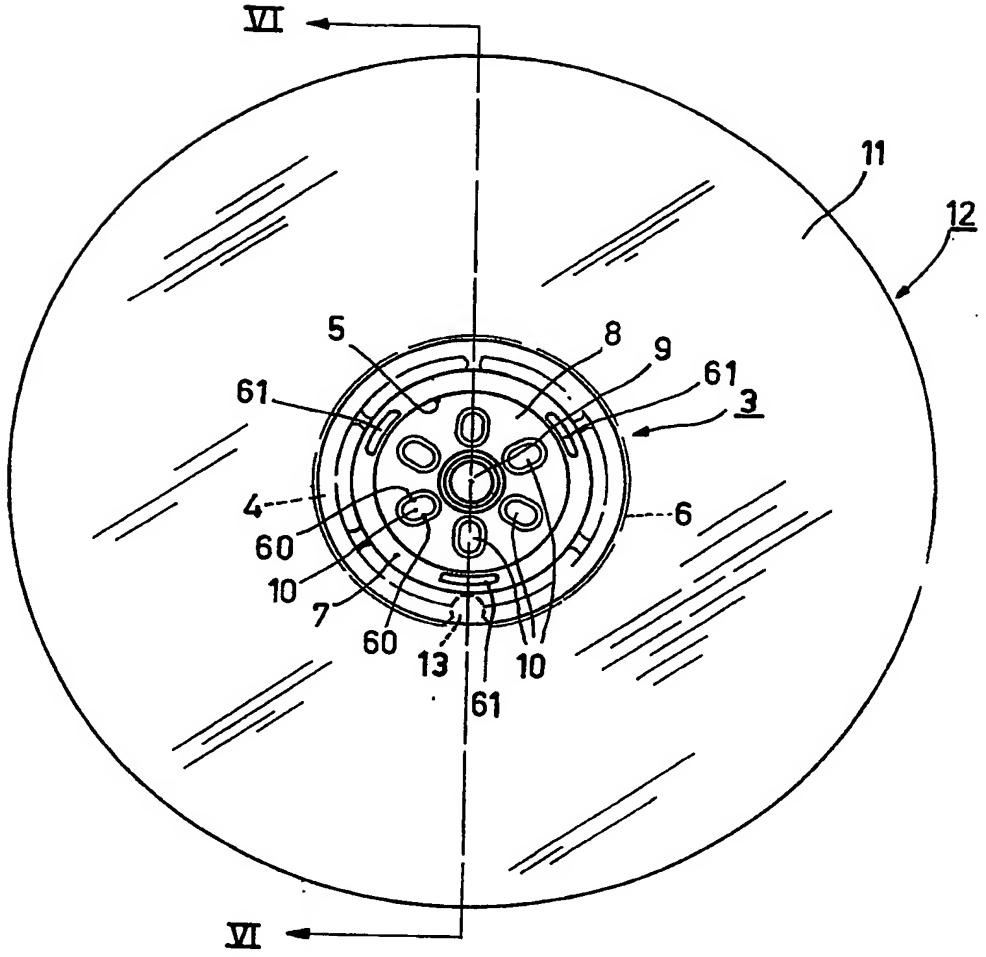
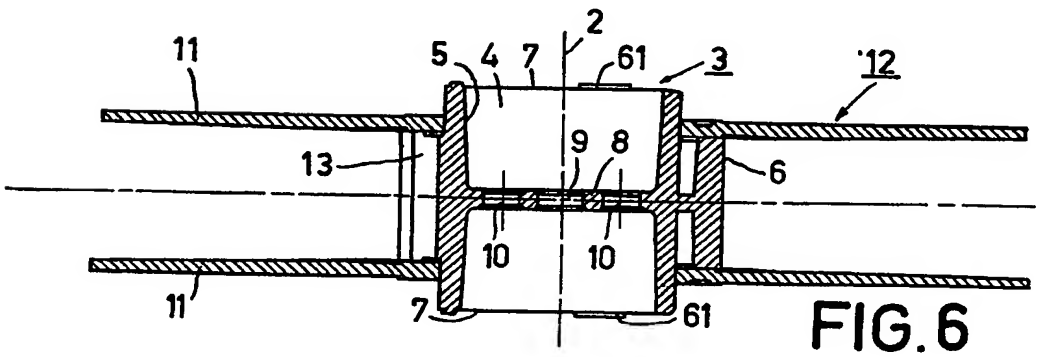

VI
11
12
5
8
9
61
61
3
4
6
60
10
7
60
13
10
61
VI

FIG.5


2
11
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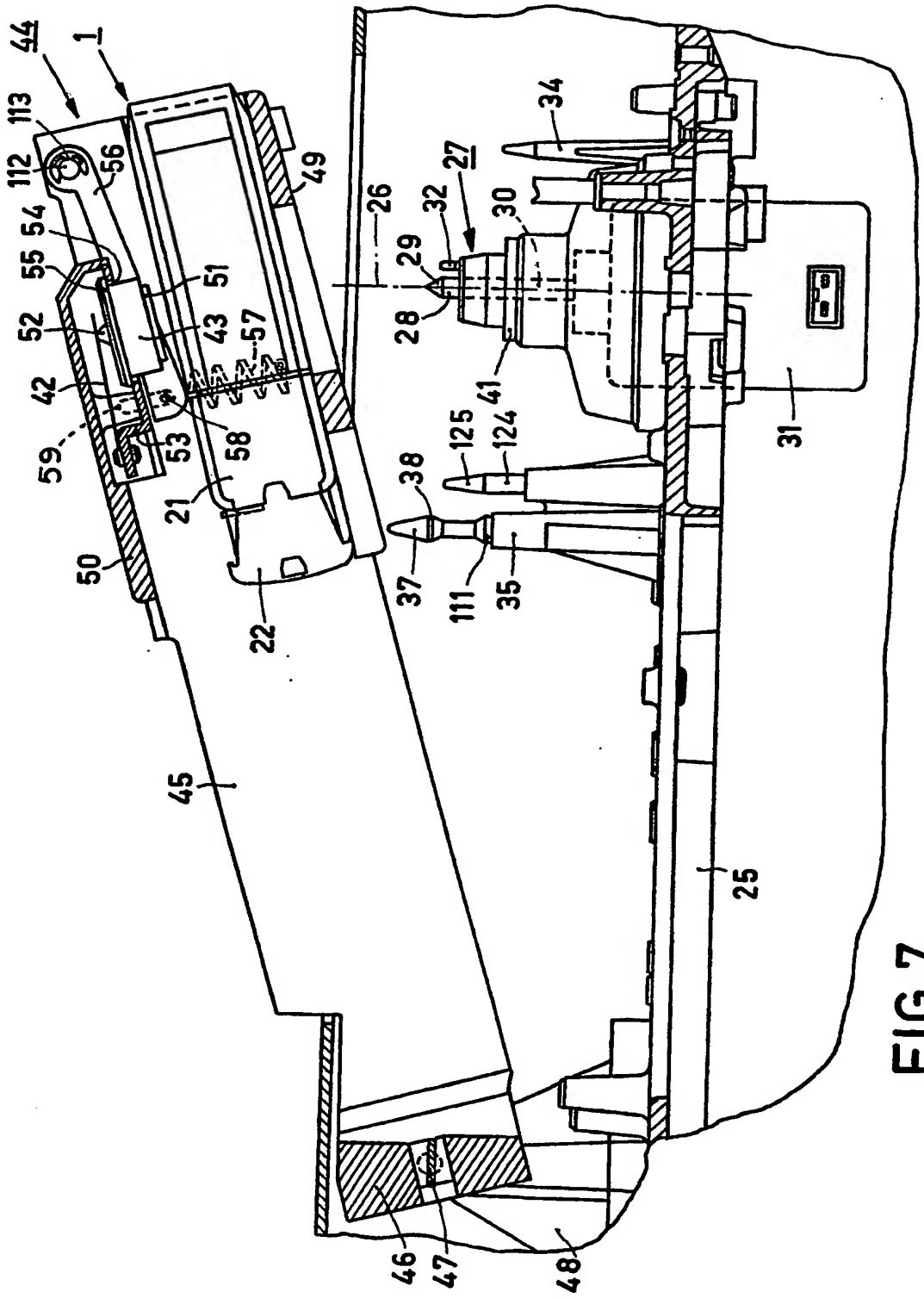
4
7
61
3
12
9
8
13
6
10
10
11
7
61

FIG.6


44
1
113
112
56
49
26
34
27
32
30
54
55
29
51
52
43
57
28
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111
35
22
45
25
46
47
48

FIG.7

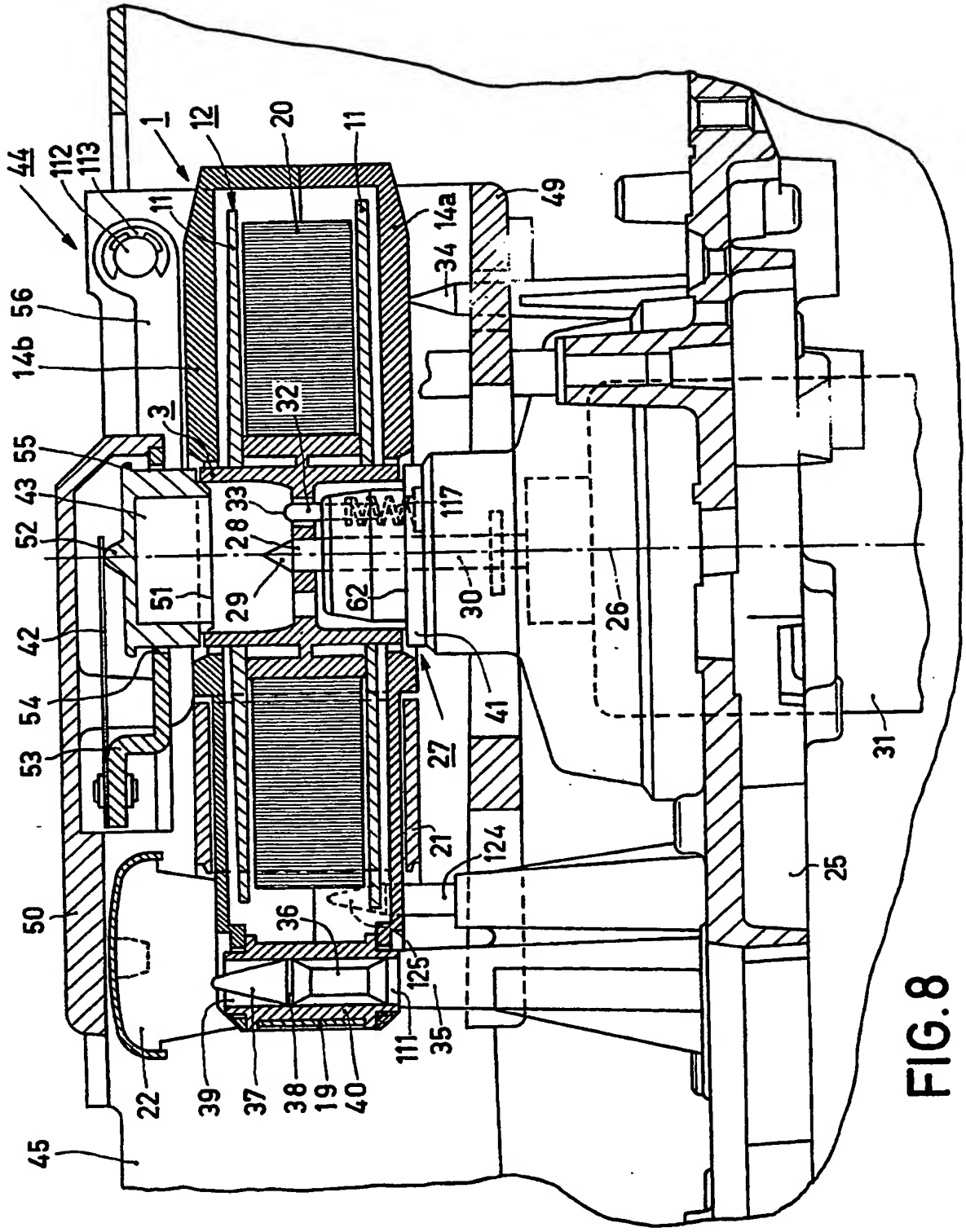
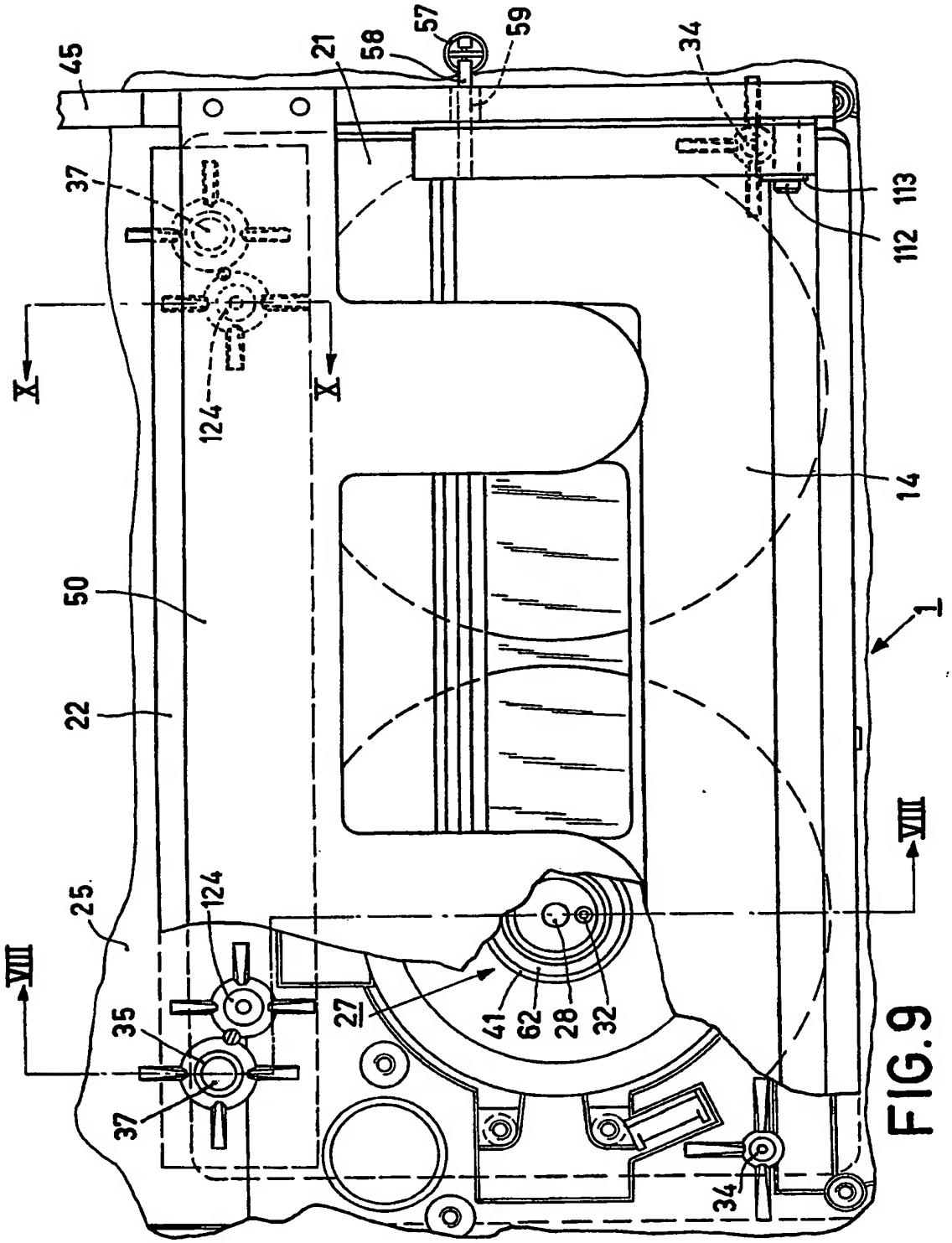

44
112
113
1
12
20
11
49
14a
34
56
14b
3
55
43
52
32
33
28
29
51
62
117
30
26
42
54
53
27
41
31
21
124
25
50
36
125
111
35
22
39
37
38
19
40
45

FIG.8


45
21
58
57
59
34
37
113
112
X
X
124
14
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1
22
VIII
25
124
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35
27
41
62
28
32
37
34

FIG.9

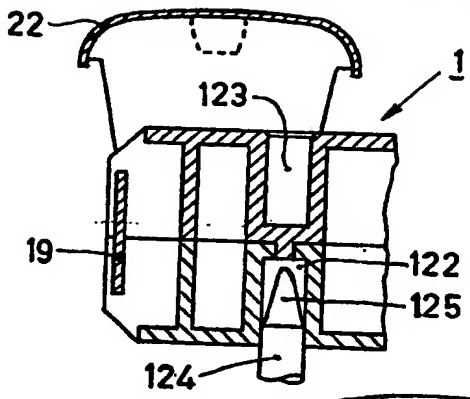


FIG. 10

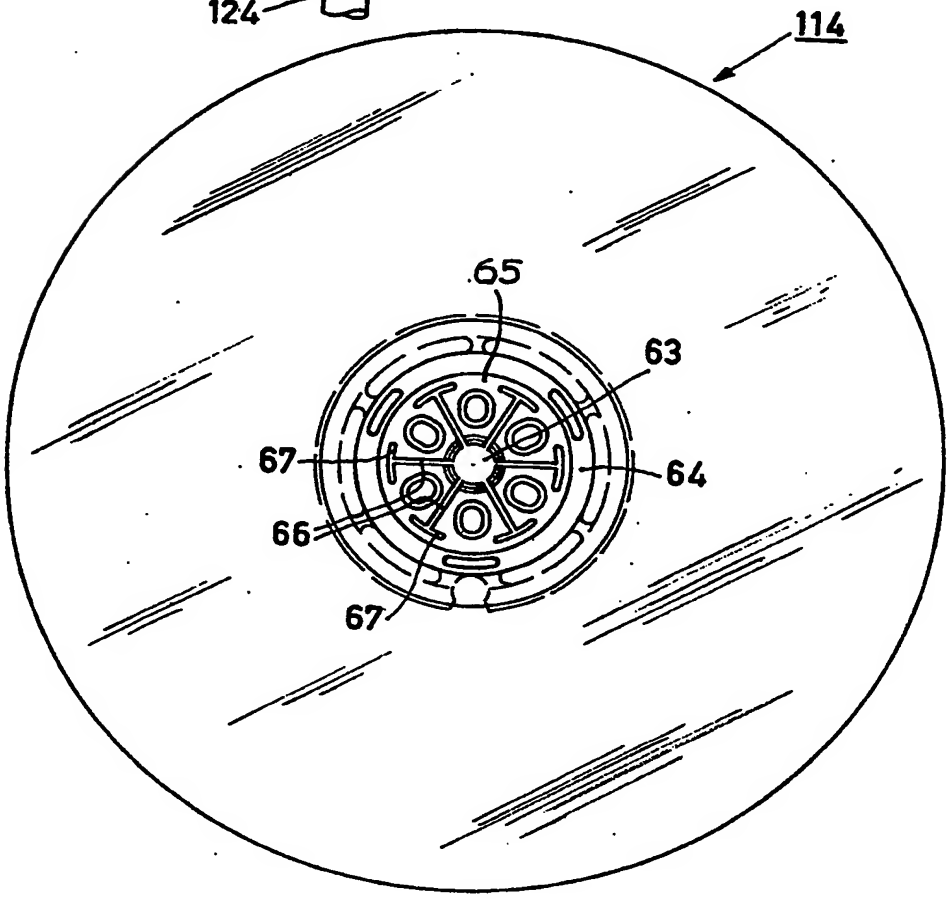
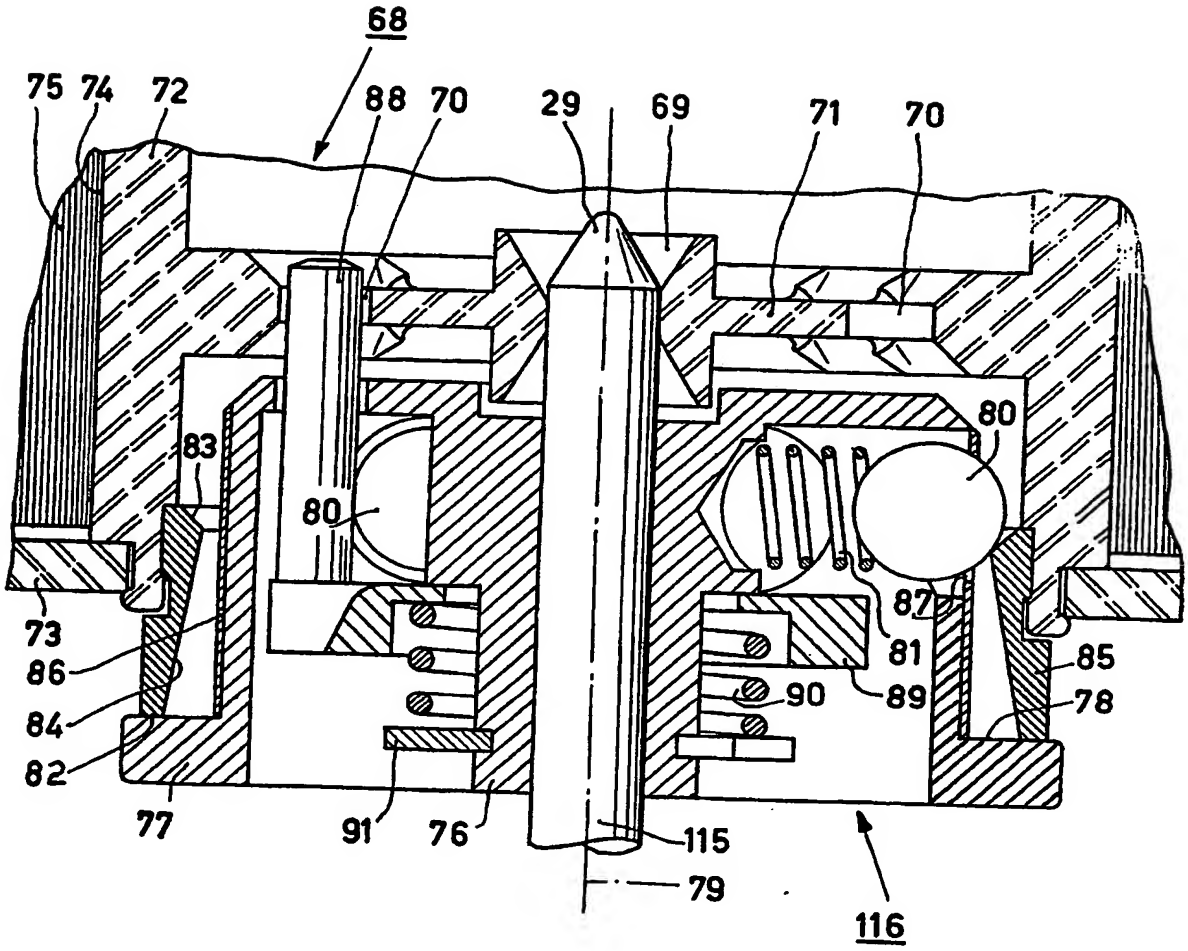


FIG. 11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85
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FIG.12

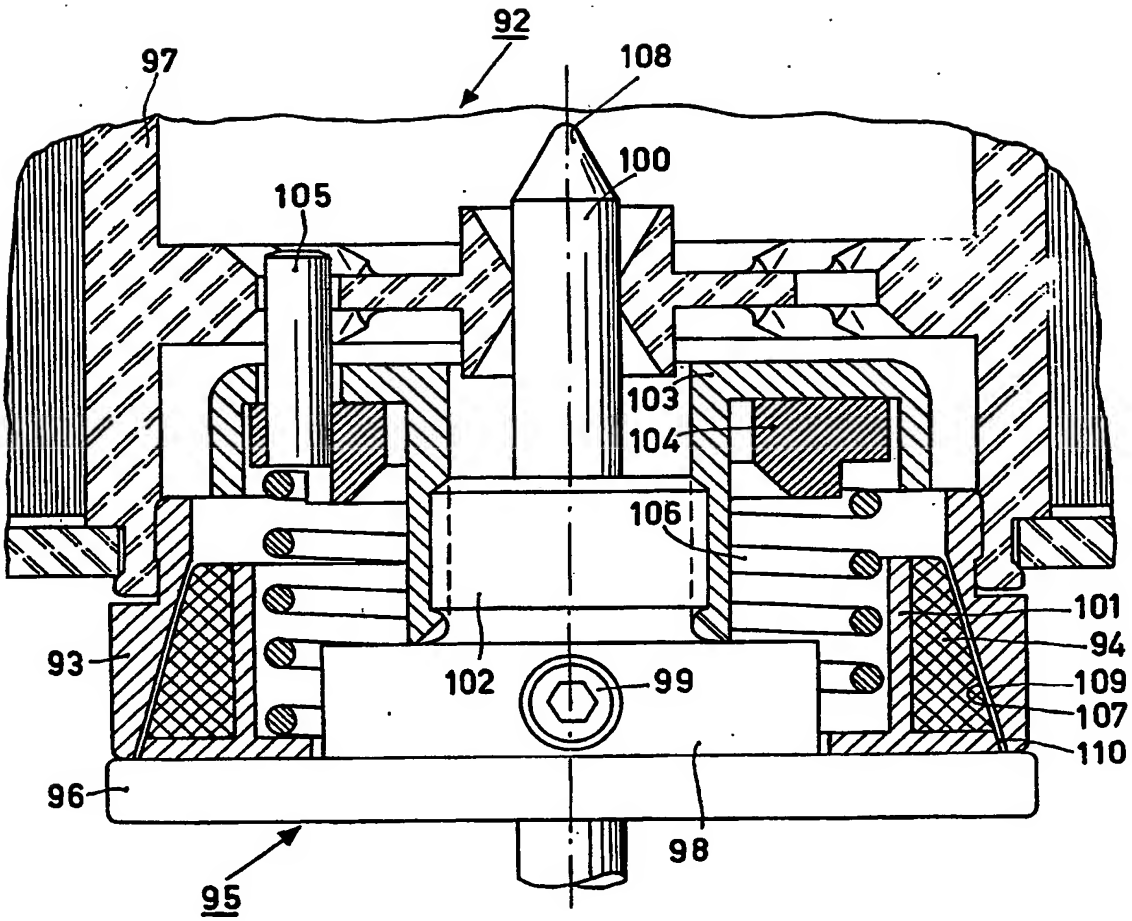

FIG. 13

SPECIFICATION

Recording and/or Playback Apparatus and Magnetic-Tape Cassette for use with the Apparatus

The invention relates to an apparatus for recording and/or playing back signals on and/or from a magnetic tape contained in a cassette, and a magnetic-tape cassette for use with the apparatus. The invention relates particularly to a recording and/or playback apparatus and a magnetic-tape cassette of the kind (hereinafter referred to as the "kind described") which is reversible, i.e., can be used selectively in a first operative position or a reversed second operative position on the apparatus, and which comprises a housing containing a magnetic tape which is carried on two reel hubs arranged side-by-side in the housing, the hubs being rotatable in the housing about parallel axes and each being constructed to receive drive from the apparatus to be rotated thereby for transporting the tape from one reel hub to the other, and the housing comprising two main walls which are disposed opposite one another in planes perpendicular to the axes of rotation of the reel hubs and between which the hubs are accommodated with axial play and which have apertures through which the reel hubs can receive drive from the apparatus, and plurality of walls which extend between the two main walls at the peripheries thereof and which include two side walls disposed opposite one another and a rear wall extending between the two side walls at one end thereof. When the cassette is not mounted on the recording and/or playback apparatus, a portion of the tape extends along the front of the cassette housing, which is the part opposite the rear wall of the housing.

In a known recording and/or playback apparatus and magnetic-tape cassette of the kind described for use with the apparatus, each reel hub of the cassette comprises a substantially cylindrical tubular body which is open at both ends and which has at each end a surface or surfaces which is or are disposed in a plane perpendicular to the axis of rotation of the hub, the body being formed with a wall which extends across the interior of the body midway between the ends thereof in a plane perpendicular to said axis and which has a central centring aperture and at least one drive aperture spaced radially from the centring aperture, and the recording and/or playback apparatus has means for driving the reel hubs of the cassette when the cassette is in either of its operative positions, which means comprise two drive spindles which are rotatable about parallel axes and each of which has a centring pin for cooperation with the centring aperture of one or the other of the reel hubs depending on which operative position is occupied by the cassette, and a drive pin which extends parallel with and is spaced radially from the centring pin for cooperation with the drive aperture or one of the drive apertures of said one or the other of the reel hubs and which is resiliently depressible in a direction parallel to the axis of rotation of the drive spindle, the apparatus also having means for cooperation with the housing of the cassette to support the cassette in either of its operative positions, in each of which positions the reel hubs of the cassette cooperate with the centring pins and drive pins of the drive spindles.

Such an apparatus and cassette are known from United States Patent Specificatin 3,027,110. This specification discloses an arrangement in which a plurality of drive apertures are formed in the internal transverse wall of each reel hub at equal radial distances from the axis of rotation of the reel hub and at equal angular distances from each other. If two separate winding motors for the two reel hubs were used, the spindles of the winding motors could also be used as centring pins for centring the reel hubs. The height positions of the reel hubs in the magnetic-tape cassette are determined by the location of the cassette on the cassette supporting means of the recording and/or playback apparatus.

The known arrangement is intended for recording and/or playing back audio signals on magnetic tape. For video applications, where signals of substantially larger bandwidth than in audio applications have to be recorded and/or played back, such an arrangement is less suitable. In the currently used magnetic video tape recorders which have been designed for the consumer market the signals are written on the magnetic tape with the aid of rotary video heads, as obliquely oriented and closely spaced tracks. The oblique tracks are approximately 18 to 23 microns wide at a length of approximately 100 mm, whilst in some magnetic tape recorders, employing two magnetic video heads with different azimuth alignments the tracks directly adjoin each other without intermediate spacing. In order to ensure that with such recorders a recording made on one specific video recorder can be played back on another video recorder without loss of quality, a high accuracy of the tape transport and the tape guidance is essential, so that variations in the stretch of the magnetic tape and thus variations in the tension in the magnetic tape are minimized. Indeed, one video recorder should be capable of reading the tracks which have been written on the magnetic tape by another video recorder, whilst furthermore time errors should also be avoided because of their adverse effect on the picture quality. In view of the stringent compatibility requirements thus imposed, the magnetic-tape reels should not be subjected to undefined friction forces. Other sources of tape tension variation should also be eliminated as far as possible. Conventional video recorders employ several servo systems so as to obtain an accurate tape transport speed and minimal tape tension variations. For example, the speed of rotation of the capstan is automatically controlled by means of a servo system, whilst other servo systems are provided for the drive of the rotary magnetic heads, for the magnetic head

control and for the drive of the drive spindles. As a result of the variations in tension which occur in the magnetic tape, frictional forces which act on the magnetic-tape reels represent errors for the last-mentioned servo systems and also for the other servo systems.

According to the present invention there is provided an apparatus for recording and/or playing back signals on and/or from a magnetic tape contained in a cassette, and a magnetic-tape cassette of the kind described for use with the apparatus, each reel hub of the cassette comprising a substantially cylindrical tubular body which is open at both ends and which has at each end a surface or surfaces which is or are disposed in a plane perpendicular to the axis of rotation of the hub, the body being formed with a wall which extends across the interior of the body midway between the ends thereof in a plane perpendicular to said axis and which has a central centring aperture and at least one drive aperture spaced radially from the centring aperture, and the recording and/or playback apparatus having means for driving the reel hubs of the cassette when the cassette is in either of its operative positions, which means comprise two drive spindles which are rotatable about parallel axes and each of which has a centring pin for cooperation with the centring aperture of one or the other of the reel hubs depending on which operative position is occupied by the cassette, and a drive pin which extends parallel with and is spaced radially from the centring pin for cooperation with the drive aperture or one of the drive apertures of said one or the other of the reel hubs and which is resiliently depressible in a direction parallel to the axis of rotation of the drive spindle, and the apparatus also having means for cooperation with the housing of the cassette to support the cassette in either of its operative positions, in each of which positions the reel hubs of the cassette cooperate with the centring pins and drive pins of the drive spindles, wherein for axially positioning the reel hubs when the cassette is in either of its operative positions, each drive spindle is provided with hub positioning means comprising stop means which rotate with the drive spindle and which are cooperable with the surface or surfaces at one or the other end of the tubular body of one or the other of the reel hubs depending on which operative position is occupied by the cassette, loading means being provided for resiliently urging the reel hubs against said stop means, and wherein the hub positioning means and the cassette supporting means are arranged so that in both operative positions of the cassette the reel hubs and the reels of tape wound thereon are entirely clear of the walls of the cassette housing.

In many magnetic video tape recorders a cassette holder is provided which is movable between an open position in which the cassette can be inserted in or removed from the holder and a closed position in which the holder retains the cassette in the selected operative position. In an embodiment of the invention in which the recording and/or playback apparatus comprises such a cassette holder, the loading means for resiliently urging the reel hubs against the stop means on the drive spindles comprise first and second reel hub loaders which are freely rotatable in the cassette holder and which are each provided with a centring portion for centring the loader relative to the tubular body of one or the other of the reel hubs, the loading means further comprising first and second springs which have point contact with the first and second reel hub loaders respectively centrally thereof on the opposite sides of the loaders to the centring portions. A first advantage of this embodiment is that minimal axial forces are exerted on the drive spindles, whilst no lateral forces due to the springs are transmitted to the drive spindles. A second advantage is that the loading means are rotation-symmetrical and consequently will not give rise to any unbalance of the tape reels, which is of special importance during rapid transport of the magnetic tape during fast forward travel or fast rewind. Speeds up to roughly 2500 revolutions per minute may then occur. Such a speed corresponds to a tape speed of approximately 3 metres per second during fast winding. Other advantages are that the construction is simple and that removal of the magnetic-tape cassette is not hampered by the drive spindles.

The cassette holder may be provided with a partly open bottom which faces the cassette supporting means and with bearing members which have bearing apertures for the two reel hub loaders, the reel hub loaders being rotatable with play and axially movable in the bearing apertures and each having an annular stop member for abutment with the associated bearing member to limit the axial movement of the loader towards the bottom of the holder, and the cassette holder may be further provided with resiliently loaded means which are arranged to act on the housing of the cassette when the cassette is inserted in the holder, so as to urge the cassette against the bottom of the holder, the distance between the reel hub loaders and the bottom of the cassette holder when the annular stop members of the loaders are in abutment with the bearing members, the dimensions of the housing of the cassette and the reel hubs and the dimensions of the cassette holder and the cassette supporting means on the drive arrangement all being so adapted to each other that in the open position of the cassette holder the cassette can slide on the bottom of the cassette holder without touching the reel hub loaders when it is being inserted into the holder, and in the closed position of the cassette holder the inserted cassette is supported by the cassette supporting means at a distance from the bottom of the cassette holder such that the reel hub loaders can cooperate with the reel hubs and at the same time be freely movable in the bearing apertures in the bearing number. With this arrangement the reel hub loaders do not

hamper insertion of the magnetic-tape cassette into the cassette holder. Furthermore, no separate aids are necessary for applying the reel hub loaders to the reel hubs, because this is effected automatically when the cassette holder is moved from its open to its closed position.

The drive apertures of the reel hubs of the cassette may be partially bounded by flat wall portions for cooperation with the drive pins of the drive spindles, the flat wall portions extending substantially radially relative to the axes of rotation of the respective reel hubs, so as to inhibit the transmission of non-tangentially directed forces from the drive pins to the reel hubs. Only minimal play is then required between the drive pins and the walls of the drive apertures, because tolerances in the radial positions of the drive pins are accommodated by the elongate shape of the drive apertures. Thus, the impact between the drive pins and the walls of the drive apertures when the rotation of the reel hubs is reversed or during starting or braking of the reel hubs will be minimized, which is beneficial to the life expectancy of the tape drive and the accuracy of the drive. Another advantage is that the bearings of the drive spindles will not be loaded unnecessarily by non-tangential forces, which obviously do not contribute to the torque to be exerted.

In order to obtain well-defined position of the reel hubs relative to the drive spindles, the stop means on each of the drive spindles has an annular stop surface which is disposed in a plane perpendicular to the axis of rotation of the relevant drive spindle, and wherein the tubular body of each of the reel is formed at each end with three axially directed projections which are spaced at equal radial distances from the axis of rotation of the relevant reel hub and at equal angular distances from each other and which form three abutment surfaces in a plane perpendicular to the axis of rotation of the relevant reel hub for cooperation with the annular stop surface of the stop means on one or the other of the drive spindles, so that the reel hubs and the stop means cooperate with each other through a three-point contact. As the reel hubs are generally manufactured from a thermo-plastics material by an injection-moulding process, the provision of the axial projections will present no practical technical problems. The stop means on the drive spindles may comprise accurately machined faces of metal stop rings.

In an embodiment of the invention which ensures an entirely play-free centring of the reel hubs on the drive spindles, the centring apertures of the reel hubs are circular and have a diameter which is smaller than the diameter of the centring pins of the drive spindles, and the internal wall of each reel hub in which the centring and drive apertures are formed has slots which extend radially of the hub and which terminate at one end in the centring aperture of the hub, the portions of said wall between the slots being flexible so that they will grip the centring pin with which the centring aperture cooperates when the cassette is in either of its operative positions.

In an embodiment of the invention which does not require the use of reel hub loaders connected to a cassette holder, the loading means for resiliently urging the reel hubs against the stop means on the drive spindles comprise a plurality of pressure members mounted on each drive spindle and each of which pressure members is movable between a first position and a second position which is nearer the axis of rotation of the relevant drive spindle than the first position, resilient being provided for loading the pressure members towards their first position, and the tubular body of each reel hub of the cassette is provided adjacent each of its ends with an internal annular abutment surface for cooperation with the pressure members on one or the other of the drive spindles, the pressure members on each drive spindle bearing in their first position on a respective one of said abutment surfaces of one or the other of the reel hubs when the cassette is in either of its operative positions, and under the action of the associated resilient means exerting on said abutment surface a force having a component which is directed towards the stop means on the relevant drive spindle. In order to enable the cassette in this embodiment to be fitted on and removed from the drive spindles with a smooth pushing action and pulling action respectively, the tubular body of each reel hub of the cassette is preferably provided between each of its ends and the adjacent annular abutment surface with a frusto-conical internal surface whose diameter decreases towards said abutment surface, for gradually moving the pressure members of one or the other of the drive spindles from their first position towards their second position until the relevant abutment surface is reached by the pressure members during the positioning of the reel hubs on the drive spindles when the cassette is being placed in either of its operative positions.

In another embodiment of the invention which does not require the use of reel hub loaders connected to a cassette holder, each of the reel hubs of the cassette is provided at each end of the tubular body of the hub with an armature ring of a magnetizable material, and each of the drive spindles is provided with magnetic means for magnetically drawing one or the other of the reel hubs against the stop means on the relevant drive spindle in cooperation with one or the other of the armature rings on the relevant reel hub. The magnetic means for pulling the reel hubs against the stop means on the drive spindles may comprise electro-magnets. By switching the electric current to the electro-magnets, the cassette can be put on and removed from the drive spindles without the exertion of axial forced on the drive spindles. Alternatively, the magnetic means on each of the drive spindles may comprise an annular permanent magnet having a frusto-conical outer surface, the diameter of which decreases towards the free end of the

centring pin, and each of the armature rings on each of the reel hubs of the cassette may have an inner surface with a frusto-conical shape corresponding to the shape of the outer surfaces of the permanent magnets on the drive spindles, the magnets and the armature rings being so constructed and arranged that when the cassette is in either of its operative positions, an air gap of substantially uniform thickness is formed between the outer surface of each permanent magnet and the inner surface of the armature ring which magnetically cooperates therewith. The advantage of the frusto-conical shape of the magnets and the armature rings mainly resides in the fact that when mounting the magnetic-tape cassette on the drive spindles, initially a large air gap is present between each magnet and the cooperating armature ring, so that the centring of the reel hubs on the centring pins of the drive spindles is not adversely affected by magnetic forces exerted on the reel hubs during centring. The shape of the outer surfaces of the permanent magnets and the inner surfaces of the armature rings may be so selected that an optimum force-path characteristic is obtained. When the cassette is in either of its operative positions, the permanent magnets on the drive spindles are surrounded by the armature rings of the reel hubs, so that magnetic stray fields can be shielded in a satisfactory manner.

Embodiments of the invention will now be described in more detail with reference to the accompanying drawings, in which

Figure 1 is a plan view of a reversible video cassette according to an embodiment of the invention and which is provided with a pivotable front cover,

Figure 2 is a perspective view of the video cassette of Figure 1,

Figures 3 and 4 are views similar to Figure 2 showing the front cover pivoted to a first open position and a second open position respectively,

Figure 5 is a plan view of a spool of the video cassette shown in the preceding Figures,

Figure 6 is a sectional view taken on the line VI—VI in Figure 5,

Figure 7 is a sectional side view of part of a video recorder according to an embodiment of the invention for use with the cassette shown in Figures 1 to 6 and which is provided with a pivotable cassette holder, the holder being shown in an open position in which a cassette can be inserted in or removed from the holder.

Figure 8 is a section view of part of the video recorder of Figure 7 to a larger scale and with the cassette holder swung down into a closed position, the section being taken on the line VIII—VIII in Figure 9,

Figure 9 is a plan view of the part of the video recorder shown in Figure 8, with portions of the cassette holder and the housing of the cassette broken away to show the parts situated beneath them,

Figure 10 is a sectional view taken on the line X—X in Figure 9,

Figure 11 is a plan view of a spool with a modified reel hub suitable for the cassette shown in the preceding Figures, and

Figures 12 and 13 are axial sectional views, drawn to a greatly enlarged scale, of two further modified reel hubs suitable for the cassette and correspondingly modified drive spindles suitable for the video recorder.

The various parts of the recorder and of the cassette are designated by different reference numerals but where two parts are identical these bear the same reference numeral and are distinguished from one another by the addition of "a" or "b" to the numeral when this is necessary for a correct understanding of the drawings.

The video cassette 1 (Figures 1 to 4 and Figures 7 to 9) is a reversible magnetic-tape cassette which is adapted to cooperate with rotary magnetic heads of a video recorder in a first operative position and in a reversed second operative position. The cassette is provided with first and second reel hubs 3*a* and 3*b* which are arranged side-by-side for rotation about parallel axes 2 (Figure 6). As shown in Figures 5 and 6, each reel hub comprises a substantially tubular body 4 having a substantially cylindrical inner surface 5, a substantially cylindrical outer surface 6 and at each end an annular surface 7 which is disposed in a plane perpendicular to the axis of rotation 2. The body 4 of each reel hub is formed with a wall 8 which extends across the interior of the body 4 midway between the ends thereof in a plane perpendicular to the axis 2 and which has a central centring aperture 9 and six drive apertures 10 spaced radially from the centring aperture 9. To both sides of the reel hub 3 transparent flanges 11 are secured. The assembly comprising the reel hub 3 and the two flanges 11 constitute a spool 12. For attaching a magnetic tape to the reel hub the hub has a recess 13 in its outer surface 6. One end of the magnetic tape is pressed into the recess 13 and retained therein by means of a resilient clamping member, not shown.

The two spools 12 are accommodated with axial play between the two main walls 14 of the housing of the cassette, which walls are disposed opposite one another in planes perpendicular to the axes of rotation of the spools and each have a first aperture 15*a* which is coaxial with the first reel hub 3*a* and a second aperture 15*b* which is coaxial with the second reel hub 3*b*. The main walls 14 are interconnected by two side walls 16, a rear wall 17 and a partly open front wall 18 which is disposed opposite the rear wall 17. The cassette contains a length of magnetic tape 19, which is connected at one end to the first reel hub 3*a* and at the other end to the second reel hub 3*b*. In the operation of the recorder the tape is unwound from a reel 20*a* on the first reel hub 3*a* and wound onto a reel 20*b* on the second reel hub 3*b* or *vice versa*, according to whether the cassette is in its first or second operative position. When the cassette is not mounted on the recorder a portion of the tape extends in a straight line

along the front of the cassette housing. A slide 21 is slidable on the cassette housing to a retracted position (Figures 3 and 4) in which it releases a pivotable front cover 22 of the housing to allow this cover to be swung open in a first direction (see Figure 3) or in a second direction (see Figure 4). Although the cassette is reversible, the portion of the magnetic tape 19 which passes along the front of the cassette housing is always accessible to the relevant elements of the video recorder from the sme side, whether the cassette is in its first or second operative position. The slide 21 is resiliently loaded towards the front by means of a compression spring 23 which bears on a pressure pad 24. Each main wall of the cassette housing has an aperture 122 and an aperture 123, the latter aperture having a slightly larger dimension in a direction parallel to a line connecting the centres of the two reel hubs 3 than in a direction at right angles to this line. These apertures serve for receiving locating pins on the video recorder, as will be explained hereinafter.

The housing of the video cassette shown in the drawing, particularly with respect to the slide 21 and pivotable front cover 22, is similar to the housing of the cassette described in the specification of the Applicants' co-pending United Kingdom Patent Application No. 7915684.

For driving the reel hubs of the cassette the recorder is provided with two drive spindles 27 (Figures 7 and 8) which are mounted on a frame 25 for rotation about parallel axes 26. The spindles are each provided with a centring pin 28 having a conical free end 29 and which is adapted to cooperate with the centring aperture 9 in one or the other of the reel hubs 3 of the magnetic-tape cassette 1 when the cassette is in one or the other of its two operative positions. Each of the centring pins 28 is integral with a motor spindle 30 of an electric drive motor 31.

Extending parallel with and spaced radially from the centring pin 20 of each drive spindle 27 is an eccentric drive pin 32 with a rounded free end 33, which drive pin is resiliently depressible in a direction parallel to the axis of rotation 26 of the drive spindle 27 against the force of a compression spring 117. The drive pins are adapted to cooperate with the drive apertures 10 in the reel hubs 3 of the video cassette 1.

For supporting the video cassette in its first operative position or in its second operative position, cassette supporting means 34 and 35 are provided on the frame 25, which means cooperate with one or the other of the main walls 14 of the cassette housing, depending on which operative position is occupied by the cassette. These means 34 and 35 support the cassette in a position (see Figure 8) in which the two reel hubs 3 cooperate with the centring pins 28 and the drive pins 32 of the drive spindles 27. The supporting means 34 and 35 comprise posts which are integral with the frame 25. Metal locating pins 36 are provided on the upper ends of the posts 35 for cooperation with hollow cylindrical tape guide elements 40 in the cassette 1. The pins 36 have conical tips 37 and cylindrical portions 38 and 111 which engage in bores 39 in the tape guide elements 40. These tape guide elements extend slightly beyond the main walls 14 of the cassette housing, so that when the cassette is in its operative position the tape guide elements 40 are positioned directly on the cassette supporting means 35. Thus it is ensured that the correct position of the tape guide elements relative to the parts of the video recorder which cooperate with the magnetic tape is not affected by dimensional tolerances of the cassette housing. The tape guide elements have some radial and axial play in the main walls 14 of the cassette housing, and the locating pins 36 therefore do not serve for locating the cassette housing on the recorder. For this purpose further locating pins 124 are provided on the frame 25, as will be explained later herein.

For axially positioning the reel hubs 3 when the cassette is in either of its operative positions, each drive spindle 37 is provided with reel hub positioning means comprising stop means in the form of an annular stop 41 which rotates with the drive spindle and which is cooperable with one or the other of one or the other of the reel hubs 3, depending on which operative position is occupied by the cassette, each of the reel hubs 3 is resiliently urged against the respective stop 41 by loading means which comprise a leaf spring 42 and a loading member 43. The reel hubs 3 are then supported at such a height in the cassette housing that the spools 12 run completely clear of the walls of the housing.

The video recorder is provided with a cassette holder 44 which is movable between an open position (see Figure 7) in which the cassette 1 can be inserted in or removed from the holder, and a closed position (see Figure 8) in which the holder retains the cassette in the selected operative position. The cassette holder comprises two spaced side plates 45 connected by a rear plate 46 in which is mounted a torsion leaf spring 47 which pivotally connects the cassette holder to supports 48 on the frame 25 and which also urges the holder towards the open position. The cassette holder further comprises a bottom plate 49 and a connecting member 50 which interconnects the two side plates 45. The loading means for urging the reel hubs 3 against the stops 41 comprise reel hub loaders formed by the previously mentioned loading members 43, which are rotatably mounted in the connecting member 50 of the cassette holder 44. Each of the reel hub loaders is provided with a centring portion 51 for centring the reel hub loader relative to the tubular body of one or other of the reel hubs 3. The reel hub loaders are loaded by the leaf springs 42, which have point contact with the reel hub loaders 43 through rounded protrusions 52 which are formed centrally on the hub loaders 43 on the opposite sides thereof to the centring portions 51 and which in the closed position of the cassette holder are disposed on the axes of rotation 26 of the drive spindles 27.

On the side remote from the cassette supporting means 34 and 35 the cassette holder 44 is provided with bearing members 53 which take the form of bent material strips connected to the connecting member 50. In the bearing members 53 bearing apertures 54 are formed for the reel hub loaders 43, which apertures have a diameter such that the reel hub loaders are rotatable with play and are axially movable in the bearing apertures. Each reel hub loader is provided with a flange 55 for abutment with the associated bearing member 53 to limit the axial movement of the loader towards the bottom 49 of the cassette holder. A cassette which is placed in the cassette holder is urged towards the bottom 49 by levers 56 which are journalled on the side plates 45 and which are loaded by tension springs 57. The levers 56, which bear on the upper of the two main walls 14 of the housing of the cassette, each have a pin 58 at one end which passes through a slot 59 in the adjacent side plate 45 and on which an associated one of the springs 57 acts. At its other end each lever is mounted on a bearing pin 112 and is retained on this pin by a rotaining clip 113. The distance between the reel hub loader 43 and the bottom 49 of the cassette holder when the flanges 55 of the loaders are in abutment with the bearing members 53, the dimensions of the housing of the cassette 1 and the reel hubs 3 and the dimensions of the cassette holder 44 and the cassette supporting means 34 and 35 are all so adapted to each other that in the open position of the case holder (see Figure 7) the video cassette can slide on the bottom 49 of the cassette holder without contacting the reel hub loaders when it is being inserted into the holder, and in the closed position of the holder (see Figure 8) the inserted cassette is supported by the cassette supporting means 34 and 35 at a distance from the bottom 48 of the cassette holder 44 such that the reel hub loaders 43 can cooperate with the reel hubs 3 and at the same time be freely movable in the bearing apertures 54 in the bearing members 53. Thus no undesired frictional forces or torques which would have an adverse effect on the uniformity of the tape transport and the tension in the magnetic tape are exerted on the spool 12 during operation of the video recorder.

As shown in Figure 5, the drive apertures 10 in the reel hubs 3 are not round but have an elongate shape with rounded ends. In order to inhibit the transmission of non-tangentially directed forces from the drive pins 32 of the drive spindles 27 to the reel hubs 3 the drive apertures 10 are partially bounded by flat wall portions 60 which extend substantially radially relative to the axis of rotation 2 of the respective reel hub. The elongate shape moreover serves to accommodate tolerances in the radial distance of the drive pins 32 from the axes of rotation 26 of the drive spindles.

Each of the annular end surfaces 7 of the tubular body 4 of each reel hub 3 comprise three axially directed projections 61 (see Figures 5 and 6) which are disposed at equal radial distances from the axis of rotation 2 of the reel hub and at equal angular distances from each other and which form three abutment surfaces in a plane perpendicular to the axis 2 for cooperation with an annular stop surface 62 the drive spindles 27, depending on which operative position is occupied by the cassette. The annular stop surfaces 62 are disposed in a plane perpendicular to the axes of rotation 26 of the drive spindles 27. Thus the reel hubs 3 and the stops 41 cooperate with each other through a three-point contact, so that a precisely defined position of each spool on the respective stop is ensured.

As shown in Figures 9 and 10, for positioning the video cassette on the cassette supporting means 34 and 35, two locating pins 124 with conical tips 125 are provided on the frame 25 for engagement in the apertures 122 and 123 (Figure 4) in one or the other of the main walls 14 of the housing of the cassette, depending on which operative position is occupied by the cassette. The cylindrical portions of the locating pins are constructed to engage with a slight play in the apertures 122.

The modified reel hub 64 of the spool 114 in Figure 11 has a central centring aperture 63 with a diameter which is smaller than the diameter of the centring pins 28 of the drive spindles 27, and the internal transverse wall 65 of the hub in which the centring aperture and the drive apertures are formed is provided with slots 66 which extend radially relative to the axis of rotation of the spool and which terminate at one end in the centring aperture 63 and at the other end in arcuate slots 67 in the wall 65. The presence of these slots gives a slight flexibility to the portion of the wall 65 between the slots so that these portions will grip the centring pin 28 with which the centring aperture 63 cooperates. This provides excellent centring of the spool, because there is no play at all between the spool and the centring pin. Obviously, for fitting such a spool on a centring pin, some axial force is required, whilst removal of the spool also demands a corresponding axial force.

This is also the case with two other embodiments namely those shown in Figures 12 and 13. Figure 12 illustrates the cooperation between a centring pin 115 and a reel hub 68 which, like the previously described reel hubs 3, has a centring aperture 69 and six drive apertures 70 in an internal transverse wall 71 of the tubular body 72 of the hub. The hub has flanges 73 on both sides, part of one flange being shown in the drawing. On the cylindrical outer surface 74 of the hub body 72 a reel 75 of tape is wound. A hollow cylindrical member 76 is clamped onto the centring pin 115 and forms a part of a drive spindle 116. A flange 77 on the member 76 forms an annular stop and comprises an annular stop surface 78 on its upper side, which surface is disposed in a plane perpendicular to the axis of rotation 79 of the centring pin 115. In this embodiment the loading means for resiliently

urging the reel hubs 68 against the stop 77 comprise a plurality of loading members in the form of balls 80, which are mounted in the member 76 and which are movable between a first or outer position and a second or inner position which is nearer the axis of rotation 79 than the first position. The balls 80 are loaded towards their outer position by compression springs 81. The tubular body 72 of the reel hub 68 is provided adjacent each end with an internal annular surface 83 for cooperation with the balls 80. As is shown in Figure 11, the balls 80 bear on a respective one of the abutment surfaces 83 when the cassette is in either of its operative positions. The balls exert a force on the surface 83 having a component which is directed towards the stop 77. The surface 83 has a frusto-conical shape, each ball 80 bearing on the frusto-conical surface at a point which is disposed below the ball's centre.

At each end the tubular body 72 of the reel hub 68 has an annular surface 82 lying in a plane perpendicular to the axis of the hub for cooperation with the annular stop surface 78 on the drive spindle 116. Between each end surface 82 and the adjacent frusto-conical surface 83 the tubular body 72 has a second frusto-conical internal surface 84, whose diameter decreases from the surface 82 to the surface 83. The surface 84 serves to move the balls 80 gradually from their outer to their inner position until the abutment surface 83 is reached during positioning of the magnetic-tape cassette on the drive spindles. The surface 82, 83 and 84 are formed on a metal ring 85 which forms part of the tubular body 72 of the reel hub 68. On the member 76 which forms part of the drive spindle 116 a cylindrical metal sleeve 86 is fitted which retains the balls 80. The balls 80 engage in round apertures 87 in the sleeve which have a diameter which is slightly smaller than the largest diameter of the ball 80, so that the balls can project from the sleeve but cannot be pressed out of the apertures by the springs 81. An eccentric drive pin 88 is secured to a ring 89 inside the member 76. A compression spring 90 urges the ring 89 upwards and is supported at its lower end by a ring 91 fixed on the member 76. The drive pin 88 is thus resiliently depressible to a limited extent in an axial direction.

The reel hub 92 in Figure 13 is substantially identical to the hub 68 in Figure 12, except that instead of the metal ring 85 a metal ring 92 of a slightly different shape is employed. This ring functions as an armature ring and is made of a magnetizable material to cooperate with magnetic means in the form of a permanent magnet 94 which is fixed on a drive spindle 95 and by means of which the metal armature ring 93 is drawn resiliently against an annular stop 96 which forms the reel hub positioning means. This stop forms part of a member 98 which is secured by a screw 99 to a motor spindle 100, which also functions as a centring pin. The permanent magnet 94 is glued onto a plastics support 101, which by means of screws, not shown, is connected to the stop 96. The member 98 is provided with a screw-threaded portion 102 onto which a screw-threaded cap 103 is fitted. Underneath this cap is a ring 104 to which an eccentric drive pin 105 is secured. A compression spring 106 urges the ring 104 upwards and is supported at its lower end by the plastics support 101.

The permanent magnet 94 on the drive spindle 95 is annular and has a frusto-conical outer surface 107, the diameter of which decreases towards the free end 108 of the centring pin 100. The armature ring 93 has an inner surface 109 with a frusto-conical shape which corresponds to that of the outer surface 107 of the permanent magnet 94 on the drive spindle 95. When the reel hub is in position on the drive spindle, as shown in Figure 13, an air gap 110 of substantially uniform thickness is formed between the outer surface 107 of the permanent magnet 94 and the inner surface 109 of the armature ring 93. On its surface 107 the permanent magnet is provided with a large number of alternate north poles and south poles, so that the magnetic field lines are correctly shielded by the armature ring 93, which ensures that no problems can arise as a result of undesired stray fields. Moreover, the cap 103 and the stop 96 also consist of a magnetizable metal.

Claims

1. An apparatus for recording and/or playing back signals on and/or from a magnetic tape contained in a cassette, and a magnetic-tape cassette of the kind described for use with the apparatus, each reel hub of the cassette comprising a substantially cylindrical tubular body which is open at both ends and which has at each end a surface or surfaces which is or are disposed in a plane perpendicular to the axis of rotation of the hub, the body being formed with a wall which extends across the interior of the body midway between the ends thereof in a plane perpendicular to said axis and which has a central centring aperture and at least one drive aperture spaced radially from the centring aperture, and the recording and/or playback apparatus having means for driving the reel hubs of the cassette when the cassette is in either of its operative positions, which means comprise two drive spindles which are rotatable about parallel axes and each of which has a centring pin for cooperation with the centring aperture of one or the other of the reel hubs depending on which operative position is occupied by the cassette, and a drive pin which extends parallel with and is spaced radially from the centring pin for cooperation with the drive aperture or one of the drive apertures of said one or the other of the reel hubs and which is resiliently depressible in a direction parallel to the axis of rotation of the drive spindle, and the apparatus also having means for cooperation with the housing of the cassette to support the cassette in either of its operative positions, in each of which position the

reel hubs of the cassette cooperate with the centring pins and drive pins of the drive spindles, wherein for axially positioning the reel hubs when the cassette is in either of its operative positions, each drive spindle is provided with hub positioning means comprising stop means which rotate with the drive spindle and which are cooperable with the surface or surfaces at one or the other end of the tubular body of one or the other of the reel hubs depending on which operative position is occupied by the cassette, loading means being provided for resiliently urging the reel hubs against said stop means, and wherein the hub positioning means and the cassette supporting means are arranged so that in both operative positions of the cassette the reel hubs and the reels of tape wound thereon are entirely clear of the walls of the cassette housing.

2. A recording and/or playback apparatus and magnetic-tape cassette as claimed in Claim 1, wherein the apparatus comprises a cassette holder which is movable between an open position in which the cassette can be inserted in or removed from the holder and a closed position in which the holder retains the cassette in the selected operative position, and wherein the loading means for resiliently urging the reel hubs against the stop means on the drive spindles comprise first and second reel hub loaders which are freely rotatable in the cassette holder and which are each provided with a centring portion for centring the loader relative to the tubular body of one or the other of the reel hubs, the loading means further comprising first and second springs which have point contact with the first and second reel hub loaders respectively centrally thereof on the opposite sides of the loaders to the centring portions.

3. A recording and/or playback apparatus and magnetic-tape casssette as claimed in Claim 2, wherein the cassette holder is provided with a partly open bottom which faces the cassette supporting means and with bearing members which have bearing apertures for the two reel hub loaders, the reel hub loaders being rotatable with play and axially movable in the bearing apertures and each having an annular stop member for abutment with the associated bearing member to limit the axial movement of the loader towards the bottom of the holder, and wherein the cassette holder is further provided with resiliently loaded means which are arranged to act on the housing of the cassette when the cassette is inserted in the holder, so as to urge the cassette against the bottom of the holder, the distance between the reel hub loaders and the bottom of the cassette holder when the annular stop members of the loaders are in abutment with the bearing members, the dimensions of the housing of the cassette and the reel hubs and the dimensions of the cassette holder and the cassette supporting means all being so adapted to each other that in the open position of the cassette holder the cassette can slide on the bottom of the cassette holder without touching the reel hub loaders when it is being inserted into the holder, and in the closed position of the cassette holder the inserted cassette is supported by the cassette supporting means at a distance from the bottom of the cassette holder such that the reel hub loaders can cooperate with the reel hubs at the same time be freely movable in the bearing apertures in the bearing members.

4. A recording and/or playback apparatus and magnetic-tape cassette as claimed in Claim 1, 2 or 3 wherein the drive apertures of the reel hubs of the cassette are partially bounded by flat wall portions for cooperation with the drive pins of the drive spindles, the flat wall portions extending substantially radially relative to the axes of rotation of the respective reel hubs, so as to inhibit the transmission of non-tangentially directed forces from the drive pins to the reel hubs.

5. A recording and/or playback apparatus and magnetic-tape cassette as claimed in any of Claims 1 to 4, wherein the stop means on each of the drive spindles has an annular stop surface which is disposed in a plane perpendicular to the axis of rotation of the relevant drive spindle and wherein the tubular body of each of the reel hubs is formed at each end with three axially directed projections which are spaced at equal radial distances from the axis of rotation of the relevant reel hub and at equal angular distances from each other and which form three abutment surfaces in a plane perpendicular to the axis of rotation of the relevant reel hub for cooperation with the annular stop surface of the stop means on one or the other of the drive spindles, so that the reel hubs and the stop means cooperate with each other through a three-point contact.

6. A recording and/or playback apparatus and magnetic-tape cassette as claimed in any of Claims 1 to 5, wherein the centring apertures of the reel hubs are circular and have a diameter which is smaller than the diameter of the centring pins of the drive spindles, and wherein the internal wall of each reel hub in which the centring and drive apertures are formed has slots which extend radially of the hub and which terminate at one end in the centring aperture of the hub, the portions of said wall between the slots being flexible so that they will grip the centring pin with which the centring aperture cooperates when the cassette is in either of its operative positions.

7. A recording and/or playback apparatus and magnetic-tape cassette as claimed in any of Claims 1 to 6, wherein the loading means for resiliently urging the reel hubs against the stop means on the drive spindles comprise a plurality of pressure members mounted on each drive spindle and each of which pressure members is movable between a first position and a second position which is nearer the axis of rotation of the relevant drive spindle than the first position, resilient means being provided for loading the pressure members towards their first position, and wherein the tubular body of each reel hub of

the cassette is provided adjacent each of its ends with an internal annular abutment surface for cooperation with the pressure members on one or the other of the drive spindles, the pressure members on each drive spindle bearing in their first position on a respective one of said abutment surfaces of one or the other of the reel hubs when the cassette is in either of its operative positions, and under the action of the associated resilient means exerting on said abutment surface a force having a component which is directed towards the stop means on the relevant drive spindle.

8. A recording and/or playback apparatus and magnetic-tape cassette as claimed in Claim 7, wherein the tubular body of each reel hub of the cassette is provided between each of its ends and the adjacent annular abutment surface with a frusto-conical internal surface whose diameter decreased towards said abutment surfaces, for gradually moving the pressue members of one or the other of the drive spindles from their first position towards their second position until the relevant abutment surface is reached by the pressure members during the positioning of the reel hubs on the drive spindles when the cassette is being placed in either of its operative positions.

9. A recording and/or playback apparatus and magnetic-tape cassette as claimed in any of Claims 1 to 6, wherein each of the reel hubs of the cassette is provided at each end of the tubular body of the hub with an armature ring of a magnetizable material, and wherein each of the drive spindles is provided with magnetic means for magnetically drawing one or the other of the reel hubs against the stop means on the relevant drive spindle in cooperation with one or the other of the armature rings on the relevant reel hub.

10. A recording and/or playback apparatus and magnetic-tape cassette as claimed in Claim 9, wherein the magnetic means on each of the drive spindles comprises an annular permanent magnet having a frusto-conical outer surface, the diameter of which decreases towards the free end of the centring pin, and wherein each of the armature rings on each of the reel hubs of the cassette has an inner surface with a frusto-conical shape corresponding to the shape of the outer surfaces of the permanent magnets on the drive spindles the magnets and the armature rings being so constructed and arranged that when the cassette is in either of its operative positions, an air gap of substantially uniform thickness is formed between the outer surface of each permanent magnet and the inner surface of the armature ring which magnetically cooperates therewith.

11. An apparatus for recording and/or playing back signals on and/or from a magnetic tape contained in a cassette, and a magnetic-tape cassette of the kind described for use with the apparatus, the apparatus and the cassette being constructed and arranged to operate substantially as herein described with reference to Figures 1 to 10 or Figure 11, 12 or 13 of the accompanying drawings.

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